

79° and 63°; United States Experiment Station, 350 elevation, 76.3° and 65.9°; W. R. Castle, 60 elevation, highest, 79°; lowest, 61°; mean, 70.0°; United States Magnetic Station, 50 elevation, mean, 71.1°.

Ewa Mill, mean dew-point, 61°; mean relative humidity, 71 per cent; Kohala, Bond, dew-point, 64.5°; relative humidity, 82 per cent; Puunene, 66.4° and 86 per cent; Puunene, pressure 29.91; United States Magnetic Station, dew-point, 63°; relative humidity, 77 per cent.

The month was characterized by four storms, which were no doubt general. One that came in on the 1st from the previous month; then on the 11th, 22d, and finally the heavy blow which characterized the last week of the year, and which was attended by an unusual spell of low dew-point, showing winds from the far north.

Mauna Kea and Mauna Loa were heavily covered with snow at the close of the month; the storm of the 11-13th being especially marked.

Heavy surf, 1st, 12th, 28th, as centers of surf periods.

OBSERVATIONS AT HONOLULU.

The station is at 21° 18' N., 157° 50' W. It is the Hawaiian Weather Bureau station Punahou. (See fig. 2, No. 1, in the MONTHLY WEATHER REVIEW for July, 1902, page 365.) Hawaiian standard time is 10^h 30^m slow of Greenwich time. Honolulu local mean time is 10^h 31^m slow of Greenwich.

The pressure is corrected for temperature and reduced to sea level, and the gravity correction, -0.06, has been applied.

The average direction and force of the wind and the average cloudiness for the whole day are given unless they have varied more than usual, in which case the extremes are given. The scale of wind force is 0 to 12, or Beaufort scale. Two directions of wind, or values of wind force, or amounts of cloudiness, connected by a dash, indicate change from one to the other. The rainfall for twenty-four hours is measured at 9 a. m. local, or 7.31 p. m., Greenwich time, on the respective dates.

The rain gage, 8 inches in diameter, is 1 foot above ground. Thermometer, 9 feet above ground. Ground is 43 feet and the barometer 50 feet above sea level.

Meteorological Observations at Honolulu, December, 1902.

Date.	Pressure at sea level.	Temperature.		During twenty-four hours preceding 1 p. m. Greenwich time, or 1:30 a. m. Honolulu time.										Total rainfall at 9 a. m., local time.
				Temperature.		Means.		Wind.		Average cloudiness.	Sea-level pressures.			
		Dry bulb.	Wet bulb.	Maximum.	Minimum.	Dew-point.	Relative humidity.	Prevailing direction.	Force.		Maximum.	Minimum.		
1	29.91	70	69	80	66	65.8	87	s.w.	1-0	5-10	29.96	29.89	0.25	
2	29.85	68	67.3	76	69	70.7	96	s.w.	1-2	10	29.95	29.86	1.80	
3	29.85	62	60.7	77	67	67.0	89	w-s.w.	2-0	10	29.90	29.80	0.01	
4	29.91	67	65	77	61	63.3	84	s.w.	1-0	3	29.93	29.85	0.00	
5	29.94	62	60	77	65	64.0	80	s.w.-w.	1-0	2	29.97	29.88	0.00	
6	29.92	69	67	79	61	62.5	78	s.w.	0	1-9	29.98	29.88	0.00	
7	29.89	69	66	77	67	64.3	78	n-ne.	3	4	29.93	29.83	0.00	
8	29.89	70	65.5	75	67	61.0	72	n-ne.	3-4	9	29.93	29.85	0.00	
9	29.89	70	66	76	69	64.0	77	ne.	3	3	29.95	29.86	0.00	
10	29.82	64	63.7	76	68	64.7	78	ne.	4-0	3	29.92	29.81	1.07	
11	29.76	65	62.8	76	64	65.8	89	w-n.	1-0	2-8	29.85	29.73	0.80	
12	29.80	67	65	73	64	59.7	73	n-nne.	6	9	29.94	29.78	1.40	
13	29.94	69	66.5	72	65	64.5	82	ne.	4-1	7	29.96	29.87	0.15	
14	30.02	70	64	76	67	65.7	84	ne.	3	6	30.05	29.92	0.84	
15	30.07	71	66	75	68	58.7	64	ne.	3	3	30.09	29.99	0.00	
16	30.04	67	66.3	76	70	65.3	77	ne.	3	4-10	30.09	30.00	0.05	
17	30.00	66	65	80	66	66.7	84	ne-se.	1-0	4-10	30.06	29.97	0.09	
18	29.94	73	68.5	78	65	66.7	82	s-n.	1-0	9	30.04	29.92	0.03	
19	29.94	71	67	75	69	66.7	80	n-e.	1-0	10-8	29.98	29.90	0.14	
20	29.89	65	64.3	79	69	65.7	80	s-n.	1-0	2-9	29.97	29.87	0.13	
21	29.84	71	68	78	64	65.3	85	n-s.w.	0	3-0	29.93	29.83	0.00	
22	29.82	66	65.7	76	64	66.5	87	s-ne.	0	10	29.86	29.74	3.20	
23	29.89	62	61	77	66	67.3	90	s.w.	1-0	5-0	29.90	29.79	0.00	
24	29.97	68	61.5	77	61	63.0	78	nne.	1-4	5-0	29.98	29.88	0.00	
25	30.02	67	62	78	66	57.7	67	nne.	4	1-4	30.04	29.94	0.00	
26	30.03	65	61	72	64	58.7	73	ne.	4	4	30.07	29.98	0.05	
27	30.08	69	61	72	63	57.7	71	ne.	4-6	5	30.06	29.95	0.05	
28	30.02	70	61.5	73	67	56.7	64	ne.	5-3	2-5	30.06	29.97	0.06	
29	30.07	68	60.7	73	66	57.3	64	ne.	5-4	6	30.09	30.00	0.16	
30	30.02	71	64.5	75	67	58.7	67	ne.	5-4	5	30.11	29.99	0.01	
31	29.98	69	63.5	75	69	60.7	69	ne.	5-4	5	30.09	29.96	0.00	
Sums														10.20
Means.	29.937	67.8	64.4	75.9	66.0	63.1	77.7		2.3	5.2	29.938	29.890		
Departure.	-.032					0.0	+2.0			+0.8				+6.28

Mean temperature for December, 1902, (6+2+9)+8=70.8; normal is 71.8. Mean pressure for December, 1902, (9+8)+2=29.938; normal is 29.970.

* This pressure is as recorded at 1 p. m., Greenwich time. † These temperatures are observed at 6 a. m., local, or 4.31 p. m., Greenwich time. ‡ These values are the means of (6+9+2+9)+4. § Beaufort scale.

Mr. Lyons also communicates Table No. 1 showing the rainfall at stations in the district of Hamakua, on the island of

Hawaii. These stations are on a line from the north coast south southwestward toward the mountain of Mauna Kea, being on its lower slopes and at increasing elevations up to 5000 feet. They extend from the lowest station Kukaiau, at an elevation of 250 feet, southwestward toward the mountain top. The highest rainfall station is at an elevation of 5000 feet, but the summit of Mauna Kea is several miles farther on and at an elevation of 13,825 feet. We understand that the observations were originally communicated by Mr. J. M. Horner, of Kukaiau, to the Pacific Commercial Advertiser. Mr. Lyons notes that the rainfall is probably greatest at about 2000 feet elevation.

TABLE 1.—Rainfall on the lower northeast slope of Mauna Kea.

1902.	Kukaiau Mill.		Kainehe.		
	250 feet.	900 feet.	1450 feet.	3300 feet.	5000 feet.
	Inches.	Inches.	Inches.	Inches.	Inches.
January	3.29	4.31	4.14	2.77	
February	3.52	4.72	13.09	2.55	
March	62.76	79.41	93.89	78.30	27.01
April	8.23	12.32	14.74	22.77	4.96
May	17.51	22.15	29.88	7.08	9.60
June	5.99	5.68	12.65	4.88	2.75
July	2.69	2.02	2.48	0.06	0.60
August	14.66	18.44	32.62	9.88	0.60
September	8.34	5.90	8.06	2.52	0.92
October	6.95	6.61	9.96	5.68	0.34
November	13.45	15.37	19.56	10.36	6.50
December	24.99	27.18	84.89	33.24	1.50
Total	172.38	204.61	275.46	180.59	*54.78

* For 10 months only.

The complete record for the above-mentioned station Kainehe, at the elevation of 1450 feet, and for nine years, is as in Table 2:

TABLE 2.—Monthly rainfalls at Kainehe.

Month.	Year.								
	1894.	1895.	1896.	1897.	1898.	1899.	1900.	1901.	1902.
January	3.00	6.81	12.84	6.67	28.42	.49	5.32	9.49	4.14
February	11.69	10.32	14.46	5.72	5.35	.74	10.14	8.60	13.09
March	21.49	28.21	20.43	4.41	30.35	19.70	4.85	25.66	93.89
April	6.90	39.48	12.84	4.32	8.05	15.84	11.62	3.57	14.74
May	.34	5.86	10.56	1.57	4.12	3.54	16.14	.46	29.88
June	2.35	1.25	6.26	2.03	2.05	2.81	3.48	.21	12.65
July	3.98	9.65	3.93	1.67	5.58	5.96	2.62	1.07	2.48
August	4.66	7.77	9.27	6.70	4.59	7.22	4.17	.26	32.62
September	.35	6.92	1.50	1.44	1.03	1.60	1.15	.70	8.06
October	2.84	3.67	6.41	.89	3.19	23.35	7.59	5.03	9.96
November	20.25	11.54	1.15	9.60	3.47	8.00	18.14	17.66	19.56
December	17.84	.67	11.17	7.60	10.99	.09	5.71	14.75	34.89
Totals	95.69	131.55	110.92	62.62	107.19	89.34	90.93	87.36	275.46

CLOUD BURSTS.

By H. H. TEN BROECK, Braidentown, Fla., dated September 26, 1902.

In the MONTHLY WEATHER REVIEW for May, 1902, page 265, there is an article on a tornado in which the writer mentions as one of the results the formation of hollows in the ground. Such facts are sometimes doubted. I have seen several such excavations, a dozen or more. They all occurred during storms of unprecedented precipitation; the excavations were about 15 to 20 feet in diameter and about 5 feet deep. On the hillside above them there was no more than the ordinary disturbance of the surface made by a heavy rain. The excavations were all well defined and at a short distance looked as though they were cellars dug for houses; those that I saw first I mistook for such cellars, and asked "Who is going to build?" but was told, "No one that we know of." I went to the spot and found two excavations, about 6 or 8 yards apart, on the side of a bluff. The evidence was conclusive that they were made by columns or spouts of water falling from the clouds on a slant; on one side the roots of the vegetation were turned over, as with a plow; on the other side they were undermined and hung over the hole. The earth, rocks, trees, etc., were

washed down the cliff and lay in a pile. There was no stream or running water anywhere near, no gulleys or ravines. Everywhere else the grass, leaves, twigs, etc., lay undisturbed on the ground, as they always do in such places. The only possible cause of the excavations was spouts of water falling on these places. I afterwards found a number of other similar excavations. These were all in Pierce County, Wis., near the Mississippi River, and were made in 1879.

CLIMATOLOGY OF COSTA RICA.

Communicated by H. PITTIER, Director, Physical Geographic Institute.

[For tables see the last page of this REVIEW preceding the charts.]

DECEMBER, 1902.

Notes on the weather.—On the Pacific side rains were generally in excess of the normal, and occasionally showers have interrupted the gathering and the preparation of the coffee. In San José the pressure was normal, the mean temperature slightly above the average, the humidity and rain scarce. On the Atlantic slope the weather did not show any special features. During the whole month the sunsets were characterized by their brilliancy, which was most remarkable on the night of the 9th. On that date the entire horizon was seen tinged with a deep fire-red color, the intensity of which diminished toward the zenith. The phenomenon began when the sun was about 5° above the horizon and lasted until about 9 p. m.

Notes on earthquakes.—December 8, 6^h 22^m a. m., slight shock NW-SE, intensity II, duration 9 seconds; 2^h 28^m p. m., slight tremors, NW-SE, intensity I, duration 3 seconds. December 9, 5^h a. m., shock NE-SW, intensity II, duration 6 seconds. December 10, 6^h 6^m a. m., tremors E-W, intensity I, duration 6 seconds. December 11, 3^h 7^m a. m., tremors. December 15, 5^h 5^m a. m., light shock ENE-WSW, intensity II, duration 6 seconds; 12^h 13^m, p. m., tremors ENE-WSW, intensity I, duration 4 seconds. December 16, 4^h 6^m a. m., oscillatory movement, WNW-ESE, intensity III, duration 8 seconds. December 18, 4^h 13^m 22^a a. m., strong shock WNW-ESE, intensity IV, duration 5 seconds; 4^h 19^m 30^a a. m., strong shock ESE-WNW, intensity IV, duration 6 seconds; 5^h 35^m a. m., sudden shock ESE-WNW, intensity III, duration 4 seconds; 5^h 43^m 52^a a. m., slight shock WNW-ESE, intensity II, duration 3 seconds; 5^h 47^m 20^a a. m., tremors; 3^h 9^m p. m., slight shock, intensity II, duration 3 seconds.

RECENT PAPERS BEARING ON METEOROLOGY.

W. F. R. PHILLIPS, in charge of Library, etc.

The subjoined titles have been selected from the contents of the periodicals and serials recently received in the library of the Weather Bureau. The titles selected are of papers or other communications bearing on meteorology or cognate branches of science. This is not a complete index of the meteorological contents of all the journals from which it has been compiled; it shows only the articles that appear to the compiler likely to be of particular interest in connection with the work of the Weather Bureau. Unsigned articles are indicated by a —.

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Lookyer, William S. J. The Similarity of the Short-period Barometric Pressure Variations over Large Areas. Pp. 224-226.

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Ward, Robert DeC. Meteorology of the Equator. [Note on article by Dr. Hann.] Pp. 428-429.

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— L'émission des rayons cathodiques par le soleil. Pp. 508-510.

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— Cause de la période annuelle de l'aurore boréale. Pp. 535-536.

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Darce, Léon. Un délesteur automatique pour ballons libres. Pp. 33-34.

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T., A. Exposition aéronautique au Grand Palais. P. 62.

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Miss R. A. EDWARDS, Library, Weather Bureau.

The Central Observatory of Belgrade, Serbia, under the di-